ican Philosophical Society was Benjamin Franklin, the second was David Rittenhouse, and the third was Thomas Jefferson.

Jefferson once proposed the establishment of a National Academy of Sciences with headquarters at Washington and branches in every State. This plan, however, did not materialize in his day. It nevertheless casts a revealing light on his mental processes. As everyone knows, he was an individualist who believed in personal initiative and endeavor. He applied this idea in the advocacy of States' rights and against paternalism in the Federal Government. However, he did not find this attitude inconsistent with the use of Federal money for the advancement of science and the diffusion of knowledge which promoted the welfare of the people.

Of all the sciences, stratigraphic geology seemed least interesting to Jefferson. He said that he "could not see any practical importance in knowing whether the earth was six thousand or six million years old, and the different formations were of no consequence so long as they were not composed of coal, iron, or other useful minerals."

PALEONTOLOGY.—*A revision of the genus* Steganocrinus.[1]

EDWIN KIRK, U. S. Geological Survey.

Nearly 50 years have passed since the publication of Wachsmuth and Springer's monographic treatment of the North American Crinoidea Camerata. Material collected for some years prior to 1897 and since that time has added considerably to our knowledge of many of the genera and rendered revisions of some of them imperative. Springer had intended to do this work and did so for several genera. Some 30 years ago I pointed out to him that a new genus was represented within the group of species referred to *Steganocrinus*. He agreed that this was so. Doubtless owing to the pressure of more important affairs and ill health, Springer passed *Steganocrinus* by, along with many other projects he had in mind. Several species have erroneously been described under *Steganocrinus*, and one genus has been based on a typical form of the genus. At this time the more obvious synonymies and incorrect citations will be dealt with. The type of *Steganocrinus concinnus* (Shumard) has been found and proves to be much like the original figure of Shumard and quite unlike the forms subsequently referred to it by authors.

Genus **Steganocrinus** Meek and Worthen

Genotype.—*Actinocrinus pentagonus* Hall, Meek and Worthen, 1866, p. 195.

Synonym.—*Shumardocrinus* Miller and Gurley. (*Genotype: Actinocrinus concinnus* Shumard, Miller and Gurley, 1895, p. 40.)

Meek and Worthen (1866, p. 195) described the genus *Steganocrinus*, including in it *Actinocrinus pentagonus* Hall, *A. sculptus* Hall, and *A. araneolus* Meek and Worthen. They twice indicate *A. pentagonus* as the typical species, and this genotype has been recognized generally. In a letter to Wachsmuth, dated June 6, 1866, Worthen states: "We have made a genus of *Act. araneolus* which we have named *Steganocrinus*." It has rather generally been assumed that Meek was the responsible author of most of the Meek and Worthen descriptions. In the present instance it appears that Worthen was unaware of Meek's choice of *pentagonus* as type of the genus, although the volume must have been in press at the time the letter was written. Of even more interest for our present purposes, Worthen elsewhere in the same letter writes: "Mr. Meek desires me to ask you if you have a specimen of *Act. sculptus* with any portion of the arms attached; if so he would much like to see it. Perhaps you have only seen it in some other collections, and if so he would like to know whether there is more than one arm to each ray." Further, in a postscript, Worthen writes: "Mr. Meek also wishes to know if you have seen the summit of *Act. sculptus*, and know if it has a proboscis." It is evident that Meek was uncertain at the time whether *A. sculptus* was properly to be placed in *Steganocrinus*.

As restricted, the genus *Steganocrinus* forms a compact, characteristic group of crinoids known at present only in the Burlington limestone and its equivalents of the lower Missis-

[1] Published by permission of the Director, U. S. Geological Survey. Received May 20, 1943.

sippian. Formerly the genus was considered chiefly to be represented in the lower Burlington, but later collections have shown it to be well represented in the upper Burlington. The theca bears a striking resemblance to *Actinocrinus* in form and ornamentation and can be told with certainty only from the structure of the *post-I Ax* brachials. Imperfect specimens, specifically known to be *Actinocrinus*, are often to be found in collections labeled as *Steganocrinus*. All the species described by Miller and Gurley as *Steganocrinus* are referable to *Actinocrinus*. This was inexcusable, as the specimens are in an excellent state of preservation.

The theca of *Steganocrinus* runs a very similar gamut of form to that found in *Actinocrinus*. The earlier species are proportionally low and wide. The later species tend to be more elongate. The tegmen is low and in most species is made up of relatively few fairly large and heavy plates. Typically the dorsal cup is lobate. The lobation in some of the later species is very pronounced. In *Steganocrinus* the *RR* and $IBrr_1$ alone are incorporated in the wall of the cup proper. The distal portion of the IBr_1 is laterally constricted. Ventrad, as seen where *IAx* is detached, there is a deep groove, the distal face of the plate having practically the appearance of a free brachial. The *IAx* flares outward sharply and is essentially a part of the free brachial series. The *IAx* frequently becomes detached, along with the arms. As noted above, it was on the assumed nonexistence of *IAx* that Miller and Gurley based their genus *Shumardocrinus*. In some of the later species of *Steganocrinus* the *R* becomes proportionally larger, the IBr_1 smaller, and the *IAx* greatly reduced.

IAx bears a pair of rami modified into what may be styled arm-trunks. They are uniserial, composed of high *Brr*, and bear relatively short, stout, biserial ramules. The drawing of *S. araneolus* (Fig. 4) is taken from Wachsmuth and Springer (1897). It shows the discrete *IAx* as regards the dorsal cup and the character of the arm-trunks. The ventral groove is covered by series of heavy plates. The structure is well shown in Figs. 1 and 2. These figures are copied from Wachsmuth and Springer (1897), where they are identified as *S. sculptus*. They are actually *S. pentagonus*. The ramules are borne on alternate sides of the ramus. Typically each *Br* bears a ramule. Exceptionally a nonramuliferous *Br* is interposed. The ramules bear pinnules.

Species referred to the genus.—

Steganocrinus araneolus (Meek and Worthen)

Actinocrinus araneolus Meek and Worthen, 1860, p. 387. "Burlington limestone, Burlington, Iowa." (Lower Burlington.)

Steganocrinus araneolus (Meek and Worthen), 1866, p. 198, pl. 15, figs. 1a, b.

Steganocrinus araneolus Wachsmuth and Springer, 1881, p. 151 (325).

Steganocrinus araneolus Wachsmuth and Springer, 1897, p. 581, pl. 61, figs. 2a, b.

It is possible that *S. araneolus* is the young of *S. pentagonus*. It is suggestive that both at Burlington, Iowa, and near Lake Valley, N. Mex., the specimens of *Steganocrinus* fall into two uniform lots. These are mainly separated by size, for the differences in shape and ornamentation could readily be explained as due to growth. There are no specimens in the collections identified as young *S. pentagonus*.

Steganocrinus concinnus (Shumard)

Actinocrinus concinnus Shumard, 1855, p. 189, pl. A, fig. 5. "Encrinital limestone, North River, Marion County, Missouri."

Steganocrinus concinnus Wachsmuth and Springer (pars), 1881, p. 151 (325).

Shumardocrinus concinnus Miller and Gurley, 1895, p. 41. (The specimen shown in pl. 2, figs. 7–10, is probably referable to *S. araneolus* (*pentagonus?*).)

Aside from having been made the type of the "new genus" *Shumardocrinus* by Miller and Gurley, this species has been universally misunderstood. Meek and Worthen (1866, p. 200) placed their *Actinocrinus validus* in synonymy with it. Wachsmuth and Springer (1897, p. 582) followed this precedent and furthermore figured as a representative of the species a form widely divergent both from *S. concinnus* and *S. validus*. The form figured by Wachsmuth and Springer is here made a new species.

Wachsmuth and Springer (1897, p. 583) stated that the type of *S. concinnus* was in the "(Worthen) Illinois State collection at Springfield." They must have been referring to the type of *S. validus*. The type of *S. concinnus* is now in the Springer collection in the United States National Museum, having come to it by purchase from Hambach.

The type of *S. concinnus* is a dorsal cup, lacking the *IAxx*. Miller and Gurley's (1895, p. 41) dogmatic assertion that the species "never had

any third radials" is, of course, utter nonsense. It was on this supposed character that the "genus" *Shumardocrinus* was principally based. The cup is in a good state of preservation. Unfortunately, no complete theca referable to the species is known to me, although one specimen from the upper Burlington near Burlington, Iowa, may be conspecific. Such characters as are shown, however, prove that the species is distinct from any described form. The specimen figured by Miller and Gurley (1895, pl. 2, figs. 7–10) could conceivably be a young individual of this species, but this is doubtful. I have not examined the specimen, but the figures as given suggest *S. araneolus* or possibly a young *S. pentagonus* from the lower Burlington.

The cup of *S. concinnus* as preserved has a maximum breadth of 30 mm and a height of but 16 mm. Were the *IAxx* preserved the height would be increased slightly and the breadth considerably increased. It is this low, broad cup that must serve at present as the chief distinguishing feature of the species. The angle of divergence of the sides of the cup is approximately 74°. The surface of the plates is traversed by sharply defined, radiating ridges, such as are common to many species both of *Actinocrinus* and *Steganocrinus*. The specimen mentioned above from Burlington has approximately the same proportions of cup. In this specimen the tegmen is nearly flat and made up of a large number of small plates, none of which is produced into a spinous process nor, indeed, is highly tumid. The type will be illustrated and described at some future time. At present it is sufficient to show that in *S. concinnus* we are dealing with a species with an exceptionally low, broad cup.

Horizon and locality.—Shumard's original citation is "Encrinital Limestone, on North River, Marion County (Missouri)," collected by Swallow. There seems little doubt, comparing the species with a large series of described and undescribed *Steganocrinus*, that the horizon is upper Burlington.

Holotype.—The holotype is in the Springer collection in the United States National Museum, S. 1181.

Steganocrinus? globosus Wachsmuth and Springer

Steganocrinus globosus Wachsmuth and Springer, 1897, p. 585, pl. 61, fig. 6. "Oolitic bed of the Kinderhook group; Burlington, Iowa."

There is no way of proving that this species is referable to *Steganocrinus*. The general form of the theca and the incorporation of the radial series in the dorsal cup argue against such an assignment. The radial series, so far as the evidence goes, indicates two discrete arms from each ray. Being unable to give the species a definite generic placement, I think it is better to leave it under *Steganocrinus* with a query.

Steganocrinus pentagonus (Hall)

Actinocrinus pentagonus Hall, 1858, p. 577, pl. 10, figs. 6a, b. "Burlington limestone, Burlington, Iowa." (Lower Burlington.)
Steganocrinus pentagonus Meek and Worthen, 1866, p. 196.
Steganocrinus pentagonus Meek and Worthen, 1868, p. 474, pl. 16, fig. 8.
Steganocrinus pentagonus Wachsmuth and Springer, 1881, p. 151 (325).
Steganocrinus pentagonus Keyes, 1894, p. 195, pl. 24, fig. 6.
Steganocrinus pentagonus Wachsmuth and Springer, 1897, p. 579, pl. 61, figs. 3a–e, 4a, b; also pl. 61, figs. 1e, f, given as *S. sculptus*.

Steganocrinus validus (Meek and Worthen)

Actinocrinus validus Meek and Worthen, 1860, p. 384.
Steganocrinus validus Miller and Gurley, 1895, p. 42.

Cited as a synonym of S. concinnus (*Shumard*).—

Actinocrinus concinnus Meek and Worthen, 1866, p. 200, pl. 15, figs. 9a, b.
Steganocrinus concinnus Wachsmuth and Springer, 1897, p. 582.

Over a period of years I have tried to locate the type of this species, but without success. It certainly is not *S. concinnus*, and almost certainly it is a good species. It is to be hoped that the specimen eventually will be found.

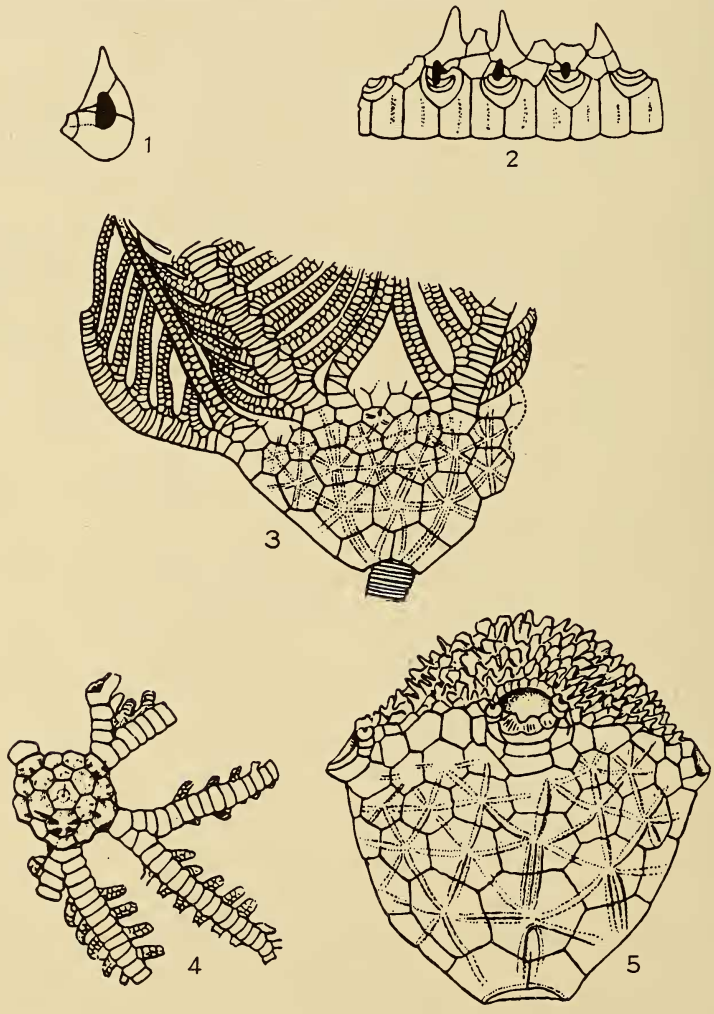
Steganocrinus elongatus, n. sp.

This species is based on the form erroneously ascribed to *S. concinnus* (Shumard) by Wachsmuth and Springer (1897, p. 582, pl. 61, figs. 5a, b). As holotype, I have chosen the specimen figured as 5a. The younger specimen, 5b, will stand as a paratype. The holotype is somewhat crushed and is abnormal as to the radial series of the anterior ray. It is, however, the best specimen known to me, and I have therefore

chosen it as type. The species is rare. In addition to the types there is a specimen larger than the holotype in the Springer collection. Most of the tegmen and a part of the dorsal cup of this specimen are missing. Furthermore, there are a few fragmentary and poorly preserved specimens. It is probable that a few specimens are to be found in other collections.

For *Steganocrinus* the species is a large one, being considerably larger than any described form. There is an undescribed species from the upper Burlington of Hannibal, Mo., that is of comparable size. The theca of the holotype has a height of 41.0 mm and an estimated maximum diameter at the arm-base, uncrushed, of about 30 mm. The paratype, as is to be expected, is relatively less elongate. The height and diameter are approximately equal.

The general habit of the species varies considerably from any described *Steganocrinus*. The cup is relatively high and not strikingly lobate. The tegmen is low and relatively small. The plates of the cup as shown by Wachsmuth and Springer are smooth. The paratype has moderately strong ridges normal to the faces of the plates. The ridges in most cases do not extend to the center of the plates. From the anal and the *r* and *l ant RR* two ridges carry to the



Figs. 1, 2.—*Steganocrinus pentagonus* (Hall): Cross section and lateral view of portion of arm-trunk.
Figs. 3, 5.—*Cyrtocrinus sculptus* (Hall): 3, Specimen showing proximal portions of arm-trunks and atrophied rami; 5, a specimen of about maximum size showing incorporation of the bachials in the cup.
Fig. 4.—*Steganocrinus araneolus* Meek and Worthen: Specimen showing brachial structures.

BB. In all other cases there is one short, broad ridge to each face of the plate. In older specimens, as in the holotype, the ridges are present but are poorly shown. They have practically been obliterated by depositions of stereom.

Relationships.—The relatively elongate theca of *S. elongatus* sharply differentiates it from any described species of the genus. *S. concinnus* (Shumard), as described above, is notable for its unusually low explanate cup.

Horizon and locality.—The species is known only from the upper Burlington. The types are from Burlington, Iowa. One or two rather poorly preserved specimens from Hannibal, Mo., may be referable to the species.

Types.—The types are in the Springer collection in the United States National Museum, S. 1182.

Cyrtocrinus, n. gen.

Synonym.—*Steganocrinus* (in part of authors).
Genotype.—*Actinocrinus sculptus* Hall.

Cyrtocrinus sculptus (Hall), n. comb.

Actinocrinus sculptus Hall, 1858, p. 582, pl. 10, figs. 11a, b. "Burlington limestone, Burlington, Iowa." (Lower Burlington.)
Steganocrinus sculptus Meek and Worthen, 1866, p. 197, text fig. 10 (in part).
Steganocrinus sculptus Wachsmuth and Springer, 1881, p. 151 (325).
Steganocrinus sculptus Keyes, 1894, p. 194, pl. 20, fig. 6 (diagram).
Steganocrinus sculptus Wachsmuth and Springer, 1897, p. 583, pl. 61, figs. 1a–d.

In *Cyrtocrinus* the dorsal cup shows practically no lobation as against the moderate to strongly developed lobation in *Steganocrinus*. This difference in lobation is a direct expression of the very different character of the radial series in the two genera. The tegmen of *Cyrtocrinus* is high and composed of large numbers of small plates. The tegmen is incompetent, in practically all specimens seen being deformed or missing in whole or part.

In very young specimens of *Cyrtocrinus* the brachial series is incorporated in the cup wall up to and including the *IAx*. In such specimens the more distal brachial structures are clearly shown. One division of the ray is hypertrophied forming a heavy arm-trunk, which bears long, stout, biserial ramules. The other half of the division is atrophied, appearing as a biserial structure similar in appearance and size to the ramules borne by the arm-trunk. With increasing age, the proximal portions of the arm-trunk and its homologue progressively become incorporated in the cup wall as shown in Fig. 5, copied from Wachsmuth and Springer (1897). In such specimens the atrophied ramus can easily be mistaken for a ramule borne by the arm-trunk. Such an interpretation has actually been made in the past.

The arm-trunk itself is uniserial, typically bearing ramules on alternate sides on each second brachial. The *Brr* are low. Occasionally there appear to be two *Brr* between ramuliferous *Brr*, but this is uncertain. The ramules are long, stout, and biserial. They bear pinnules. The base of the ramule is set into the side of the arm-trunk in such a way that it is difficult to tell from which *Br* it really originates. Unfortunately no specimens show the ventral surface of the arm-trunk. However, in specimens where a lateral view is to be had between the ramules, it appears that there is no covering of heavy plates comparable to that found in *Steganocrinus*.

Meek and Worthen (1866, p. 197, fig. 10) give a crude diagram of a portion of an arm-trunk identified as *S. sculptus* Hall. The structure as shown in this diagram was repeated by Wachsmuth and Springer (1881, pl. 17, fig. 3). Later (1897, pl. 61, figs. 1e, f) a similar structure was illustrated. These figures are here reproduced as line drawings (Figs. 1 and 2). The original of these latter illustrations is in the Springer collection. As a matter of fact, all these figures were based on *S. pentagonus*. The high, stout *Brr*, the heavy, spinous tegminal plates, and the ramules borne on each brachial clearly indicate this. The fragment illustrated when placed side by side with an arm-trunk attached to a specimen of *S. pentagonus* matches perfectly.

The splendid specimen of *C. sculptus* figured by Wachsmuth and Springer (1897, pl. 61, fig. 1a) for the first time showed the true brachial structures of this species. This specimen is diagrammatically copied, in part, as Fig. 3, from Wachsmuth and Springer (1897). As told to me by Mrs. Wachsmuth, this specimen was a late find and was probably prepared and figured without checking the figures made earlier. The diagram given by Keyes (1894, pl. 20, fig. 6) of *S. sculptus* seems actually to have been based on this specimen. The *Brr* are incorrectly

shown, however, ramules being borne by each brachial.

Relationships.—Cyrtocrinus and *Steganocrinus* show a similar modification of the rami into arm-trunks bearing biserial ramules. This is one of the numerous cases of parallel development constantly to be found among the Crinoidea. In the general habit of the theca, which is of great importance among the Camerata, one suspects a quite diverse origin for the two genera. *Cyrtocrinus* and *Cactocrinus* may well have had a common ancestry, while one would assume a similar relationship between *Actinocrinus* and *Steganocrinus*. The most obvious character that distinguishes *Cyrtocrinus* from *Steganocrinus* is the brachial structure. However, in the general habit of the theca *Cyrtocrinus* differs from *Steganocrinus* more widely, for example, than the successive genera in the *Cactocrinus-Teleiocrinus-Strotocrinus* series.

Genus **Actinocrinus** Miller

Miller and Gurley described the following species as *Steganocrinus*: *albersi*, *benedicti*, *blairi*, *griffithi*, *sharonensis*, and *spergenensis*. Bassler and Moodey (1943) have referred all these species, with the exception of *griffithi*, to *Actinocrinus*. In the case of *griffithi*, although listed as *Steganocrinus*, they state: "? = *Actinocrinites scitulus*." All the species are properly referable to *Actinocrinus*, but most of them fall into synonymy as indicated below. *Actinocrinus sharonensis* and *A. spergenensis* may be valid species. There are a number of species of *Actinocrinus* described from these higher horizons, and only by comparing the types of all the species can the proper standing of the various names be established. Miller and Gurley cite *A. spergenensis* as from the St. Louis. Obviously, this is incorrect. However, the "Probably Burlington age" of Bassler and Moodey goes too far on the other side. The crinoid itself indicates an age of at least Borden or Harrodsburg.

The remaining species described by Miller and Gurley almost certainly fall under two of the commonest and best-known species of the upper Burlington, *Actinocrinus scitulus* Meek and Worthen and *A. multiradiatus* Shumard:

Actinocrinus multiradiatus Shumard

Synonymy.—

Steganocrinus albersi Miller and Gurley, 1897, p. 33, pl. 2, figs. 13–16.

Actinocrinus albersi (Miller and Gurley), Bassler and Moodey, 1943, p. 267.

Steganocrinus blairi Miller and Gurley, 1897, p. 35, pl. 2, figs. 21, 22.

Actinocrinus blairi (Miller and Gurley), Bassler and Moodey, 1943, p. 267.

Actinocrinus scitulus Meek and Worthen

Synonymy.—

Steganocrinus griffithi Miller and Gurley, 1897, p. 34, pl. 2, figs. 17–20.

Actinocrinus griffithi (Miller and Gurley), n. comb., this paper.

Steganocrinus sharonensis Miller and Gurley, 1897, p. 32, pl. 2, figs. 10–12.

Actinocrinus sharonensis (Miller and Gurley), Bassler and Moodey, 1943, p. 274.

Actinocrinus eximius, n. name

Actinocrinus griffithi Wachsmuth and Springer, 1897, p. 568, pl. 52, fig. 7, May. (Not *Steganocrinus griffithi* Miller and Gurley, 1897, p. 34, pl. 2, figs. 17–20, Jan. 25.)

It is unfortunate that Wachsmuth and Springer's name must be suppressed as a homonym. Dr. Griffith was one of the group of enthusiastic amateurs to whom we owe so much for our knowledge of the Burlington crinoids. The species is rare, but it is a very distinct form. As holotype I have chosen the specimen figured by Wachsmuth and Springer (1897, pl. 52, fig. 7). There is no need to add to the description of Wachsmuth and Springer. Their comment (1897, p. 579) that the "arm structure approaches the genus *Steganocrinus*" may, however, be deleted.

This case and the invalid species noted above are examples of a large number of similar maleficent acts committed by Miller and Gurley. The manuscript of the Camerate Monograph was completed and transmitted for publication in 1894. The fact was well known to all. Miller and Gurley in their Bulletins of the Illinois State Museum described every specimen they could lay their hands on—good, bad, and indifferent. As was well known to their contemporaries, the main purpose was to forestall the work of Wachsmuth and Springer. Springer in his foreword in the first volume of the Monograph puts the case very mildly. Quite apart from ethical considerations, this wholesale description of species has made for a vast amount of confusion. A great many of the new species described are invalid. The drudgery involved in resolving the problems

presented is enormous and is a thankless task at best.

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BOTANY.—*Ten new American Asteraceae.*[1] S. F. BLAKE, Bureau of Plant Industry, Soils, and Agricultural Engineering.

Nine new species, six of which are from continental Mexico and one each from Texas, Baja California, and Colombia, as well as a new variety of *Corethrogyne californica* from California, are described in this paper. The single species from Colombia, *Tuberostylis axillaris*, is of special interest, belonging to a hitherto monotypic genus which seems to be unique among Asteraceae in its choice of habitat (tree trunks or roots of mangroves and perhaps other trees in saline tidal thickets). The occurrence of the two species now known, which are very distinct in characters of foliage and inflorescence, in the same restricted area at Buenaventura, Colombia, and apparently nowhere else, is of some phytogeographic and evolutionary significance.

Tuberostylis axillaris Blake, sp. nov.

Herba (?) epiphytica ubique glaberrima; folia ovata petiolata acuminata apice obtusa basi acute cuneata integra margine undulata carnosa 3-nervia evenia; capitula in axillis aggregata sessilia.

Herbaceous ?, scandent on tree trunks in tidal thickets; stem (or branch ?) simple, terete, light green, pithy, 2 mm thick; leaves opposite; internodes 2.5–4.5 cm long; petioles 1 cm long, sulcate above, connate at base; blades 4.5–6 cm long, 2.2–2.6 cm wide ,dull green, sometimes somewhat pustulate, 3-ribbed from base, the lateral veins mostly invisible; heads about 14-flowered, in axillary clusters of about 3–4, sessile, the common peduncle 1–3 mm long, bearing a few small spatulate herbaceous bracts; involucre strongly graduated, many-seriate, 7–9 mm high, the phyllaries appressed, firmly stramineous, 3-vittate, 2- or 4-ribbed, from triangular-ovate (outer) to linear (inner), all narrowed to an obtusish to acutish apex; corollas apparently whitish, cylindric without distinguishable tube, 4.2 mm long (tube 1 mm, throat 2.5 mm, teeth triangular, obtusish, 0.7 mm long); achenes narrowly oblong, bluntly 3-5-angled or -ribbed, greenish-white, epappose, 2.5–3 mm long, 0.8 mm wide.

COLOMBIA: Vine, scandent up tree trunk in tidal thickets, Buenaventura Bay, Dept. El Valle, 4 May 1939, *E. P. Killip* 35515 (type no. 1772228, U. S. Nat. Herb.).

Tuberostylis rhizophorae Steetz, the only species of the genus hitherto known, is at once distinguished by its spatulate-obovate, very ob-

[1] Received May 24, 1943.